

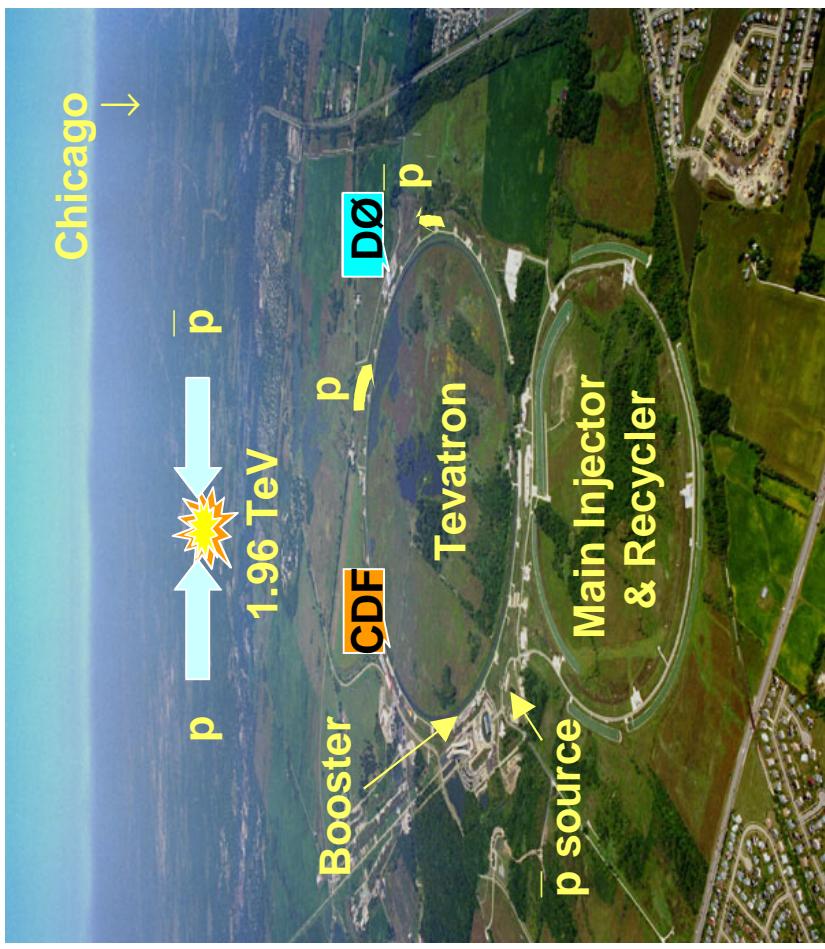
Recent Electroweak and Top-Physics Results from D0

*Markus Klute
Bonn University*

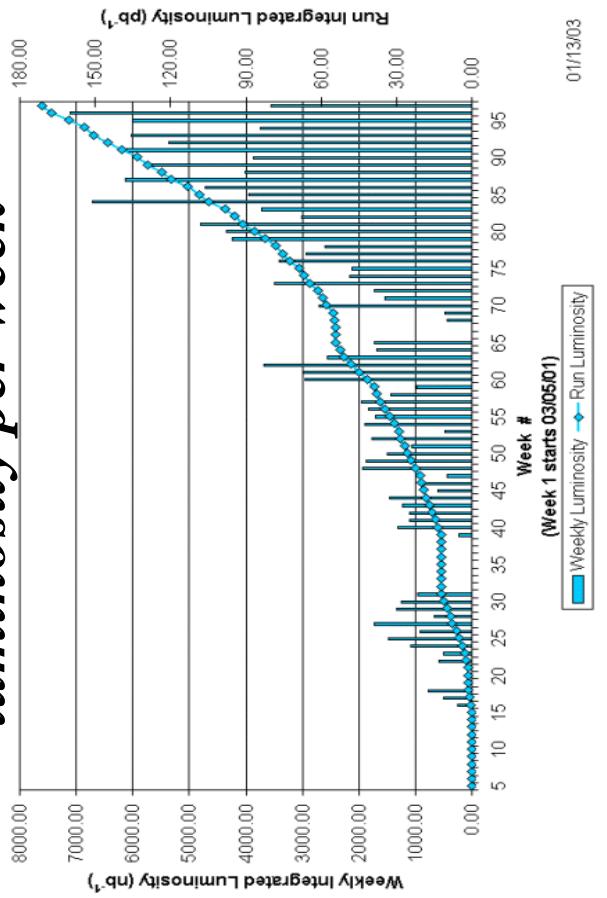
*Introduction
Results in Electroweak Physics
Progress in Top Physics
New Top Mass Measurement (RunI)
Summary*



Introduction



*RunII integrated
luminosity per week*



RunII peak luminosity $3.54 \cdot 10^{31} \text{ cm}^{-2} \text{s}^{-1}$

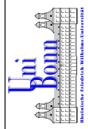
*RunI: 1992-1995 $L_{int} \sim 100 \text{ pb}^{-1}$
RunII: 2001-... $L_{int} \sim 50 \text{ pb}^{-1}$ used for physics in D θ*



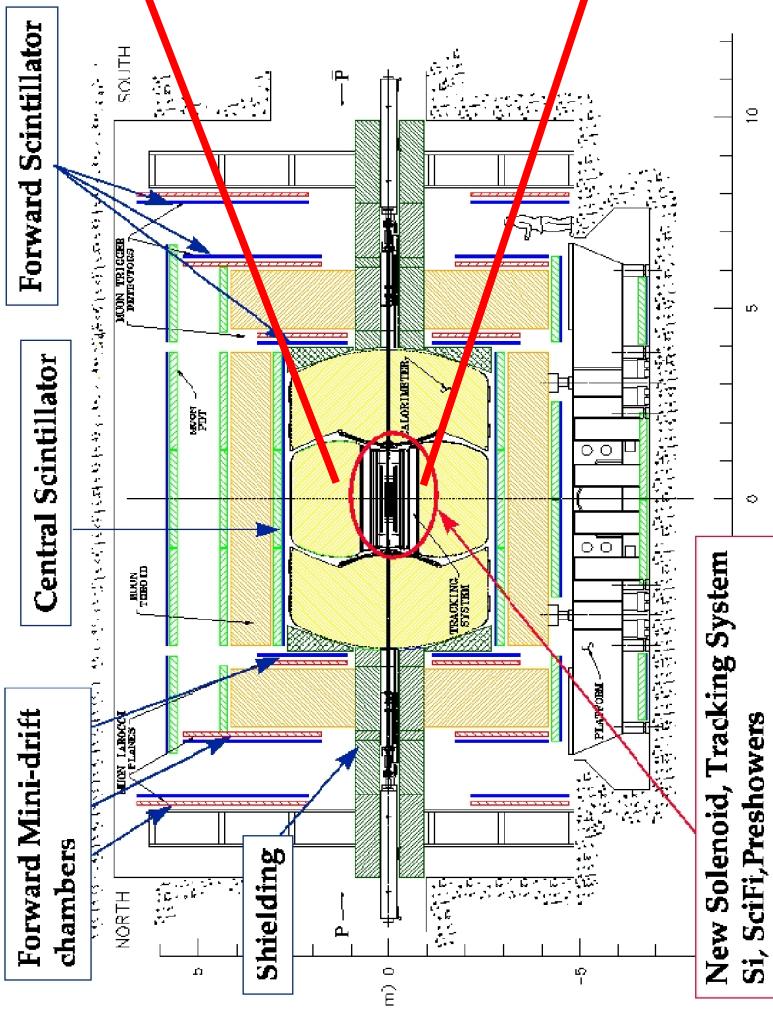
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Introduction



New Solenoid, Tracking System
Si, SciFi, Preshowers

+ New Electronics, Trigger DAQ

**DO Run II detector is built on
strength of the Run I detector:**

Lar Calorimeter

Lepton Id over large η range

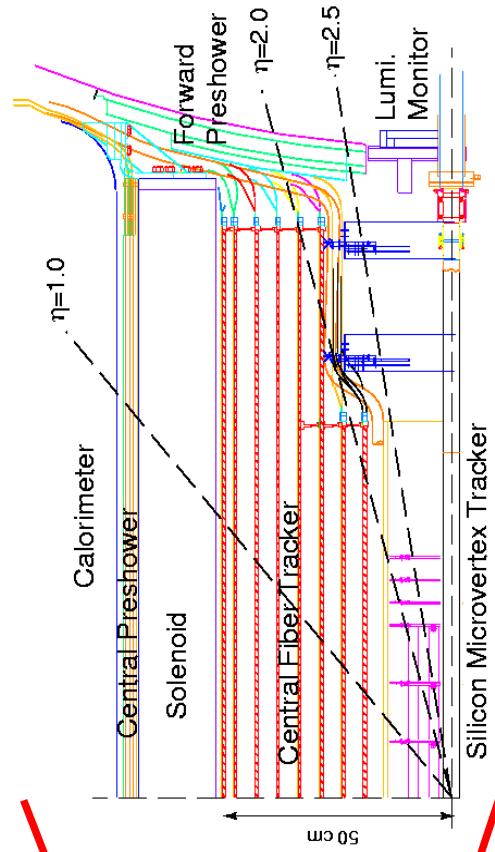
Inner tracker (silicon microstrips, scintillating fibers)

Preshower detectors

Increased shielding, upgraded muon system

Faster readout electronics

New trigger and DAQ



**DO Run II detector is built on
strength of the Run I detector:**

Inner tracker (silicon microstrips, scintillating fibers)

Preshower detectors

Calorimeter

Lepton Id over large η range

Inner tracker (silicon microstrips, scintillating fibers)

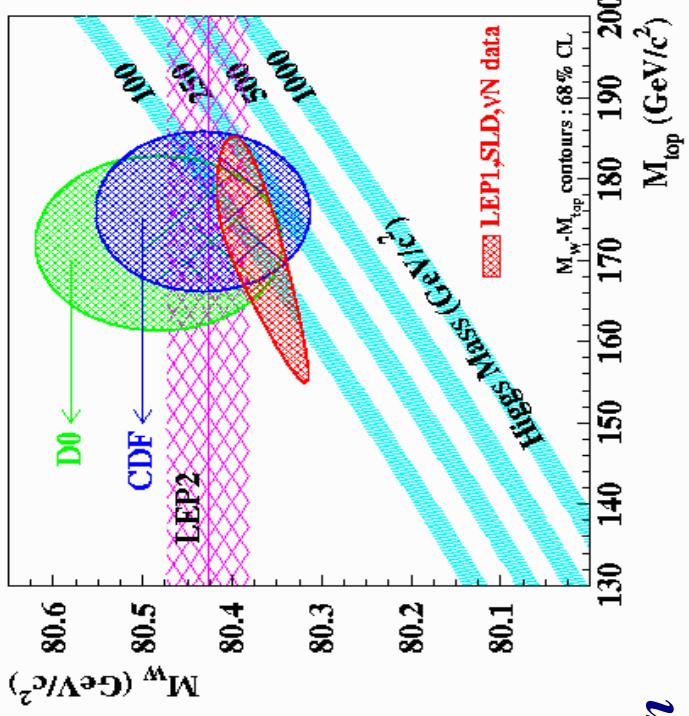
Preshower detectors



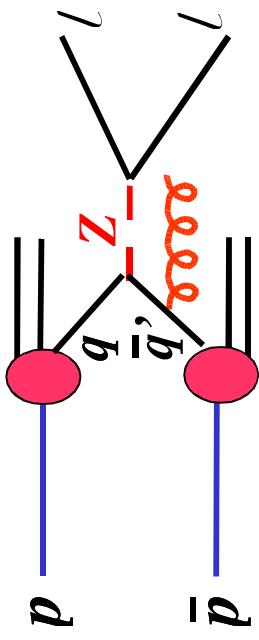
Electroweak Physics

Why do we study W's and Z's?

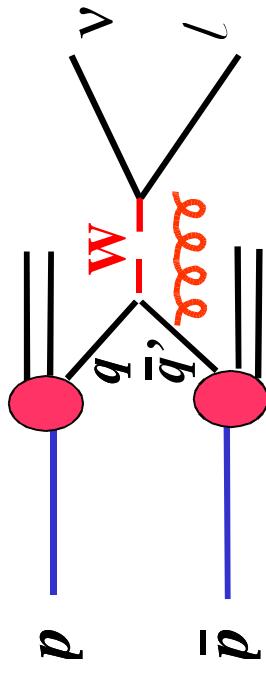
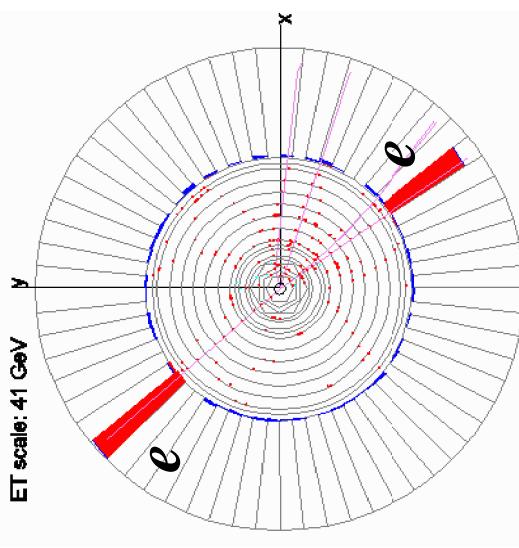
- Offer many tests of the standard model.
- Precision measurements with high statistic samples (W rate $\sim 1 \text{ Hz}$ at $2 \cdot 10^{32} \text{ cm}^{-2} \text{s}^{-1}$)
- W mass constrains Higgs mass.
- **Understanding of W / Z + jets is crucial for tt̄, single top and Higgs physics.**
- W's and Z's are great objects for calibration and reconstruction efficiency measurement.
- Reduce systematic uncertainties in other measurements.



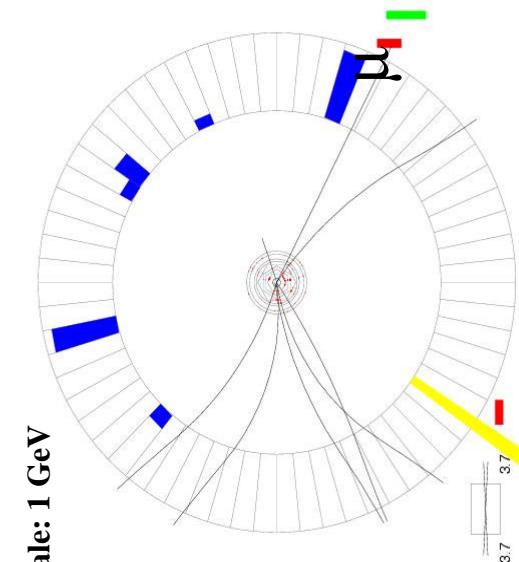
Electroweak Physics



$Z \rightarrow e^+ e^-$ (3% BR)



$W \rightarrow \mu^- \nu$ (11% BR)



2 high pT isolated leptons
Missing Et

1 high pT isolated lepton
Missing Et



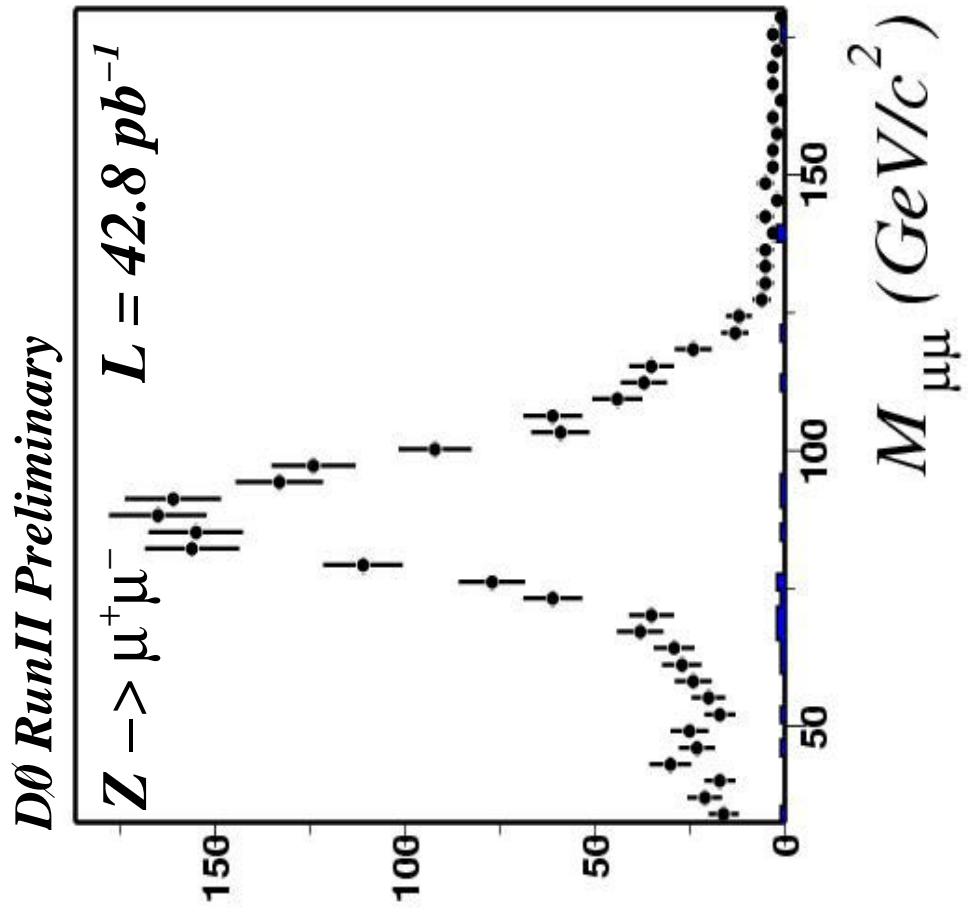
Electroweak Physics

selection:

2 μ^+ 's

$\mu p t > 15 \text{ GeV}$

one μ is isolated



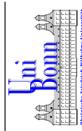
*use $Z \rightarrow \mu^+ \mu^-$ sample
to measure reconstruction
efficiencies and calibrate
simulation*

Cross section measurement is being finalized

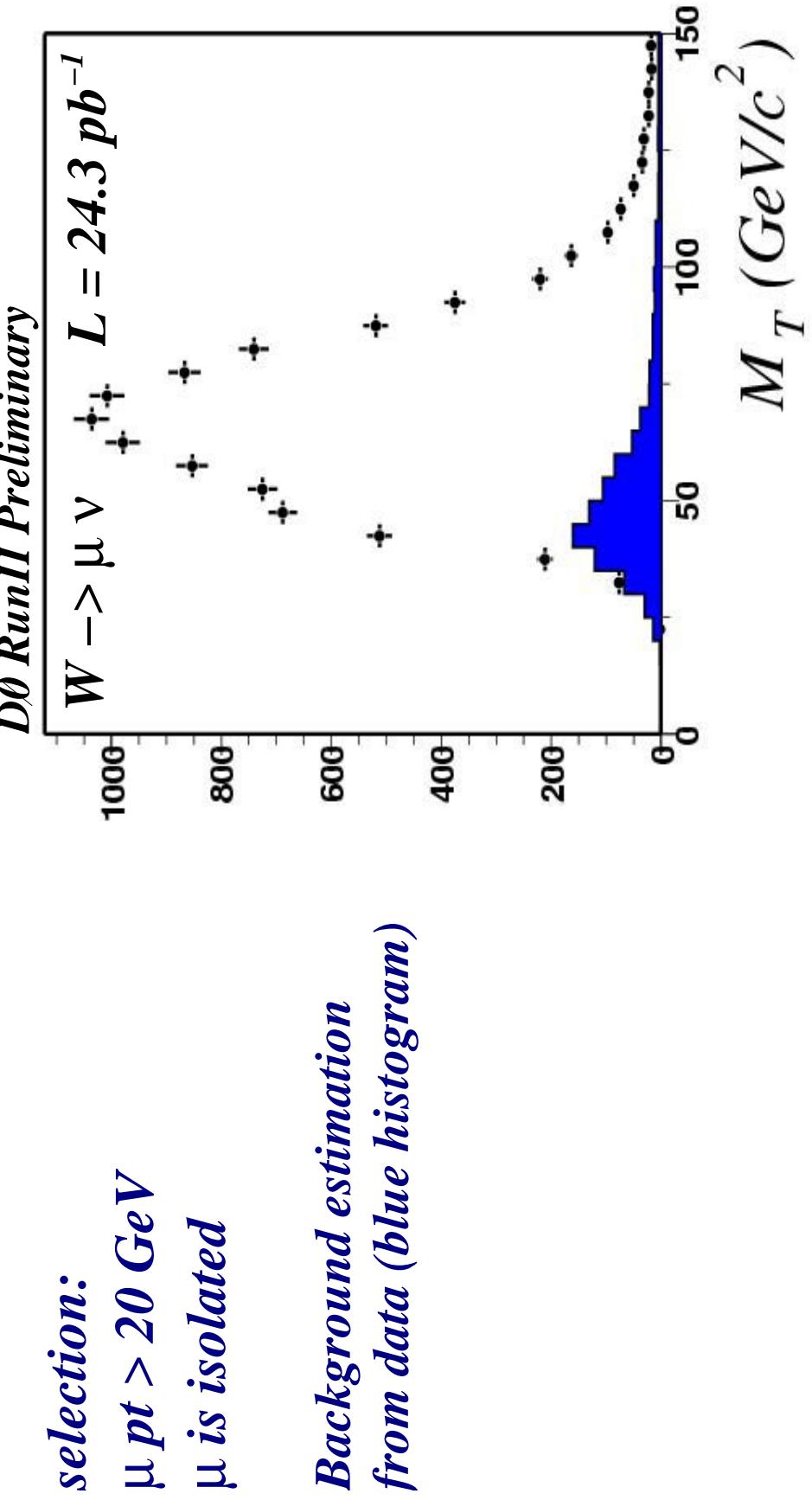


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Electroweak Physics

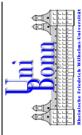


Cross section measurement is being finalized

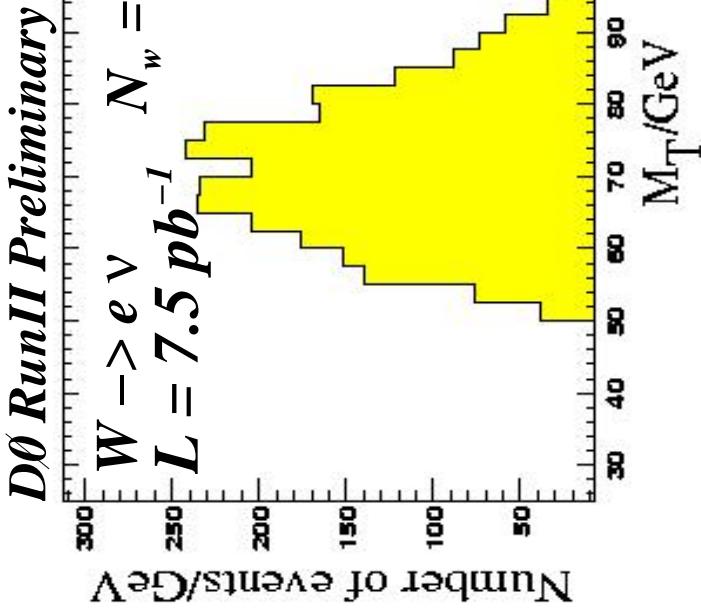
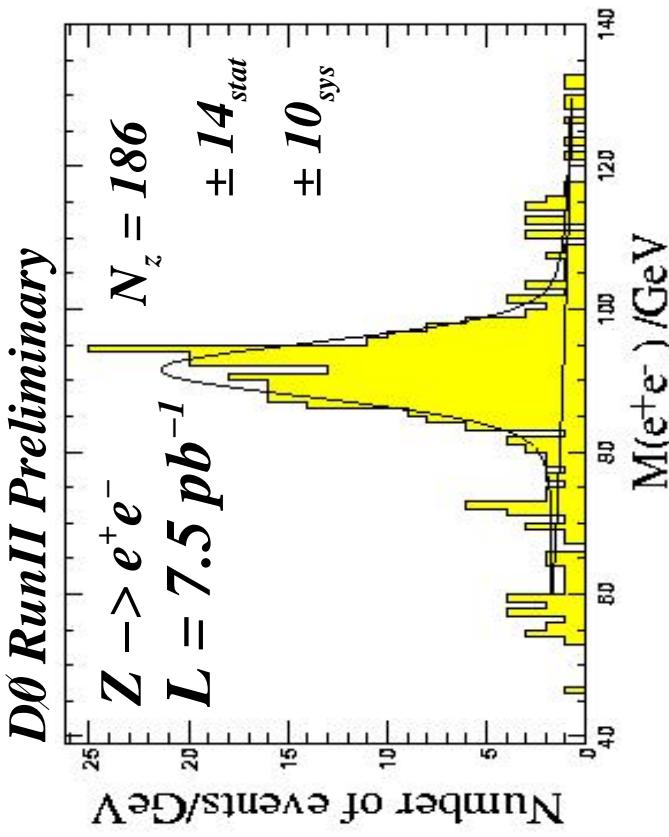


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Electroweak Physics

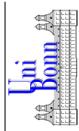


- 2 electrons $p_T > 25 \text{ GeV}$
- Sample of 328 events in only 7.5 pb^{-1}
- 206 in 80–100 GeV mass window
- Estimated background: 20 events
(from fit to Breit–Wigner convoluted with gaussian plus exponential)



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Summary / Future Prospects in EW physics

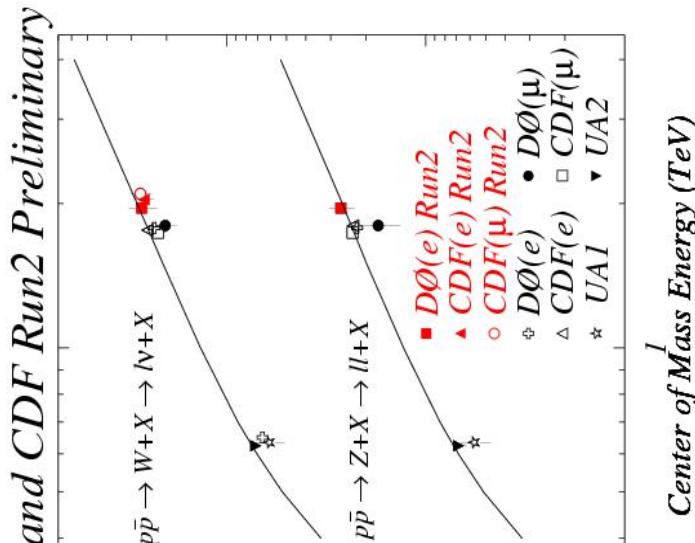
Summary

- $\sigma_Z \cdot BR = 266 \pm 20_{stat} \pm 20_{sys} \pm 27 lum\ pb$
- $\sigma_W \cdot BR = 2.67 \pm 0.06_{stat} \pm 0.33_{sys} \pm 0.27 lum\ nb$
- $R = 10.0 \pm 0.8_{stat} \pm 1.3_{sys}$

$$\Gamma_W = 2.26 \pm 0.18_{stat} \pm 0.29_{sys} \pm 0.04\ theory\ GeV$$

first $7.5\ pb^{-1}$ in electron channel only

$$R \equiv \frac{\sigma(p\bar{p} \rightarrow W + X) \times BR(W \rightarrow l\nu)}{\sigma(p\bar{p} \rightarrow Z + X) \times BR(Z \rightarrow ll)}$$
$$= \frac{\sigma(W)}{\sigma(Z)} \times \frac{\Gamma(Z)}{\Gamma(Z \rightarrow ll)} \times \frac{\Gamma(W \rightarrow l\nu)}{\Gamma(W)}$$



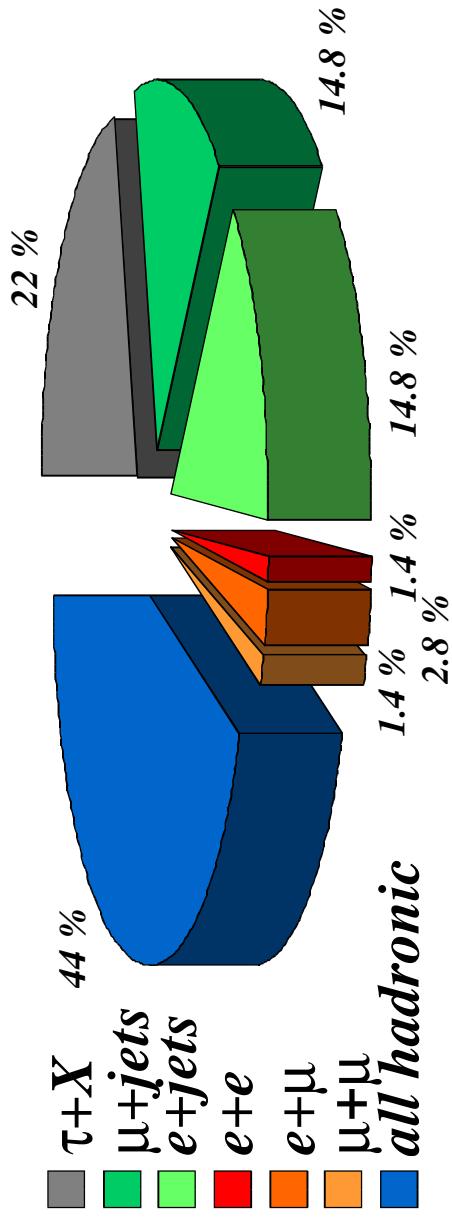
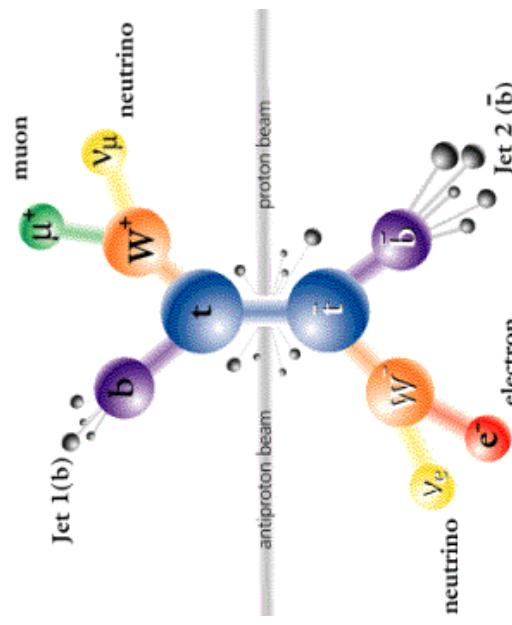
Future Prospects

- W mass ($\sim 16\ MeV$)
- W width
- Triple gauge couplings $W\gamma, Z\gamma$
- W asymmetry (PDF's)
- Z' search

Top Physics

$BR(\text{top} \rightarrow Wb) \sim 100\%$

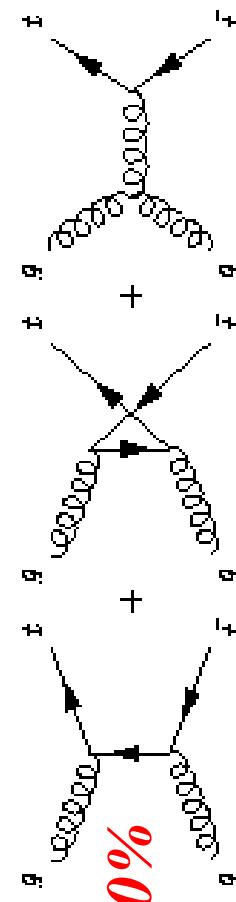
$W \rightarrow q\bar{q}$ or $W \rightarrow l^{\pm}\nu$



Top events should have either

- 2 jets, 2 charged leptons, 2 neutrinos
- 4 jets, 1 charged lepton, 1 neutrino
- 6 jets from quarks

2 jets come from b quarks



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D θ RunI Result

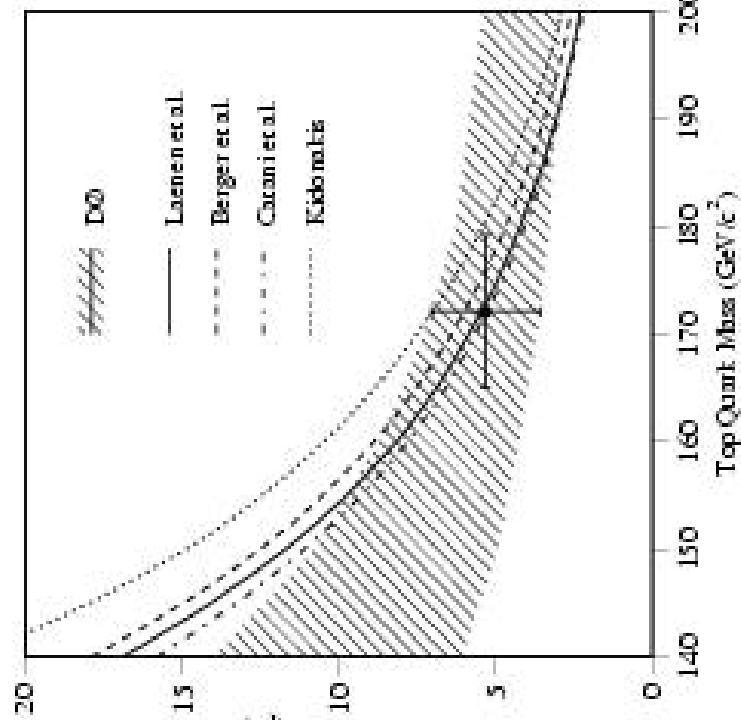
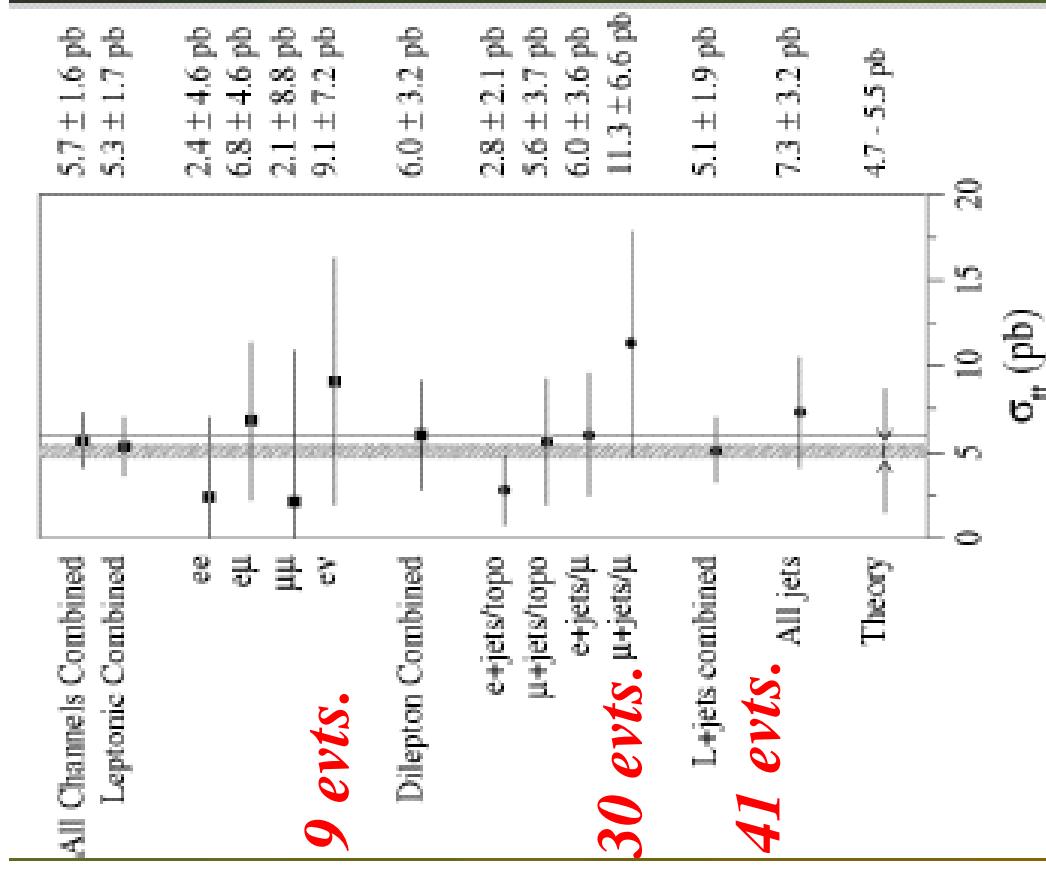
Top Physics

$$\sigma(t\bar{t}) = 5.69 \pm 1.21 \text{ stat} \pm 1.04 \text{ sys pb}$$

all channels

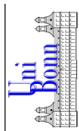
$$\sigma(t\bar{t}) = 5.31 \pm 1.34 \text{ stat} \pm 1.08 \text{ sys pb}$$

leptonic channels



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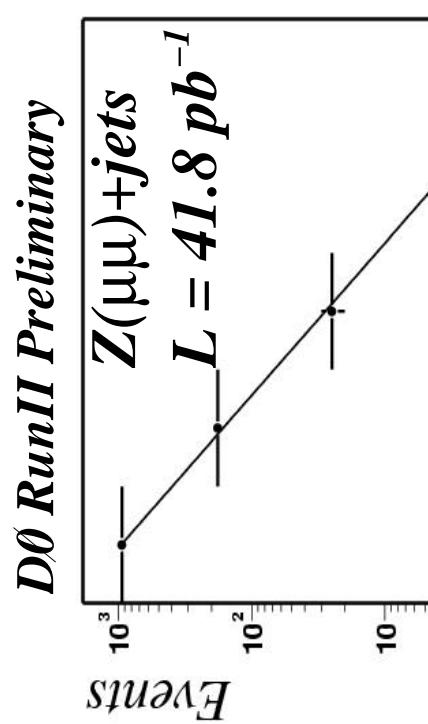
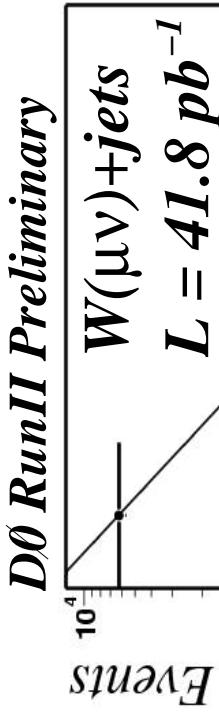
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Top Physics

W+jets and Z+jets are primary backgrounds to Top (and Higgs) physics.



For

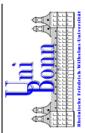
*Inclusive jet multiplicity in background subtracted $W \rightarrow l\nu$ sample — Berends scaling.
 Enhancement at $W+4\text{jets}$ after further selection indicates $t\bar{t}bar \rightarrow l\nu j + jjj$ contribution.*

Event topology or b-tagging separate $t\bar{t}bar$ contribution from $W+4\text{jets}$ and remaining QCD background.

First RunII cross section measurement is being finalized

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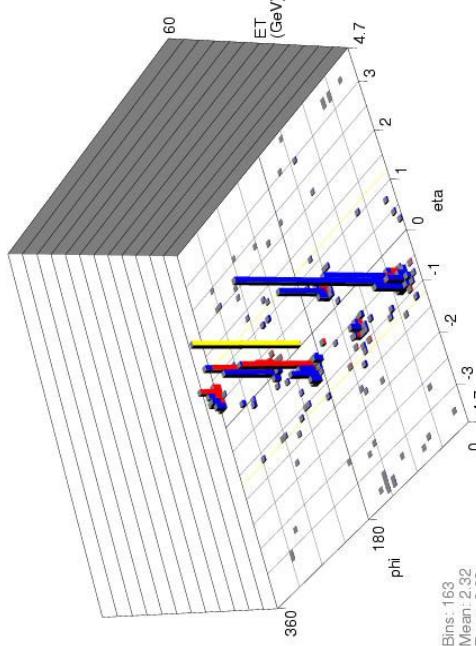
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Event Display

$t\bar{t} \rightarrow \mu\nu jjbb$ candidate

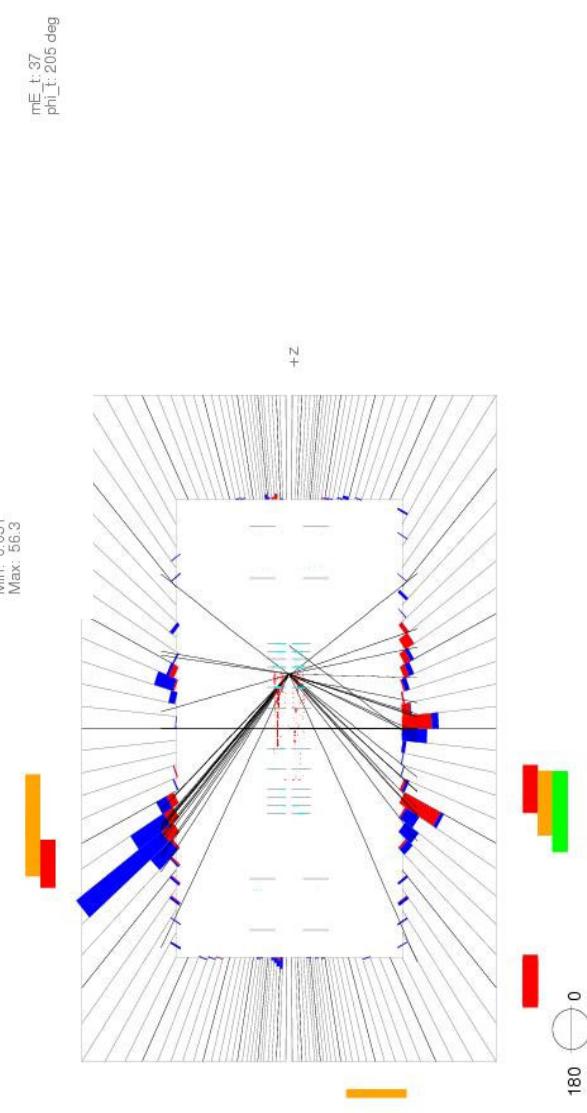
2 jets are tagged as b -jets & passes topological selection

Run 167003 Event 27714859 Sat Feb 8 23:56:45 2003

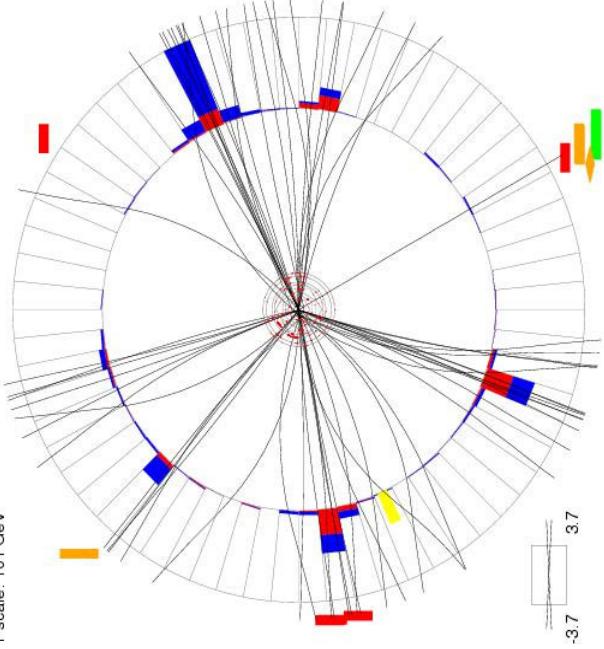


μp_t	48 GeV
MEt	55 GeV
$W p_t$	51 GeV
$JetEt$	154 GeV
A_{pla}	0.160
H_t	517 GeV

Run 167003 Event 27714859 Sat Feb 8 23:56:46 ;
 E scale: 84 GeV

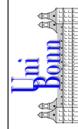


Run 167003 Event 27714859 Sat Feb 8 23:56:47 2003
 E scale: 101 GeV



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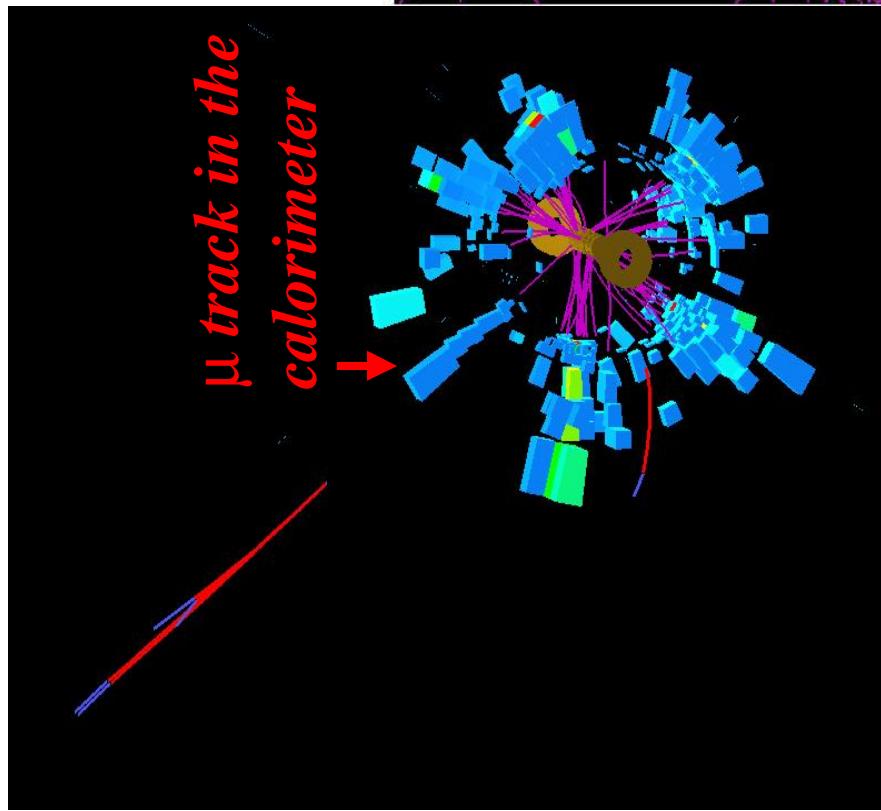
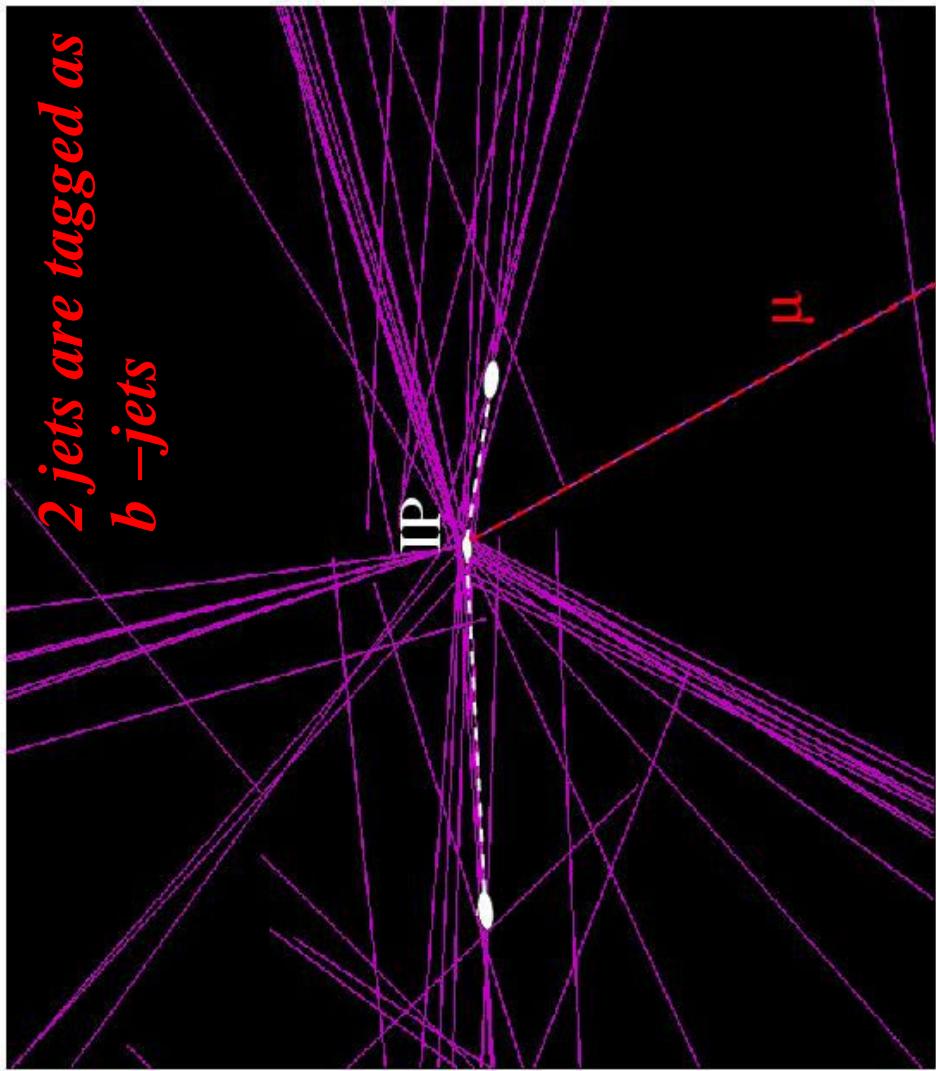
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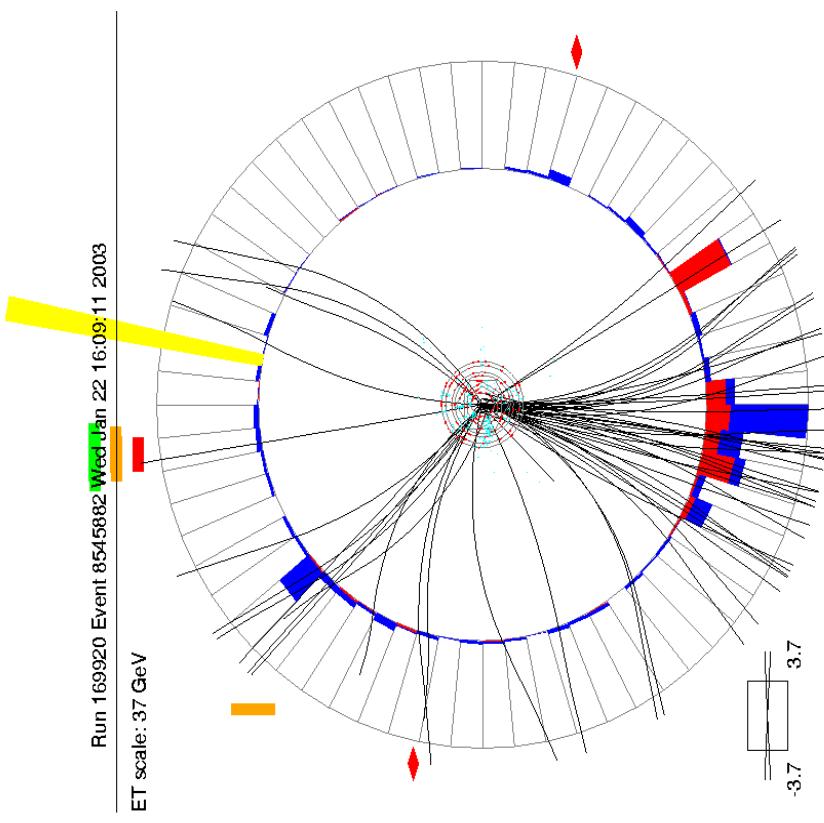
Event Display

$t\bar{t} \rightarrow \mu\nu jjbb$
candidate

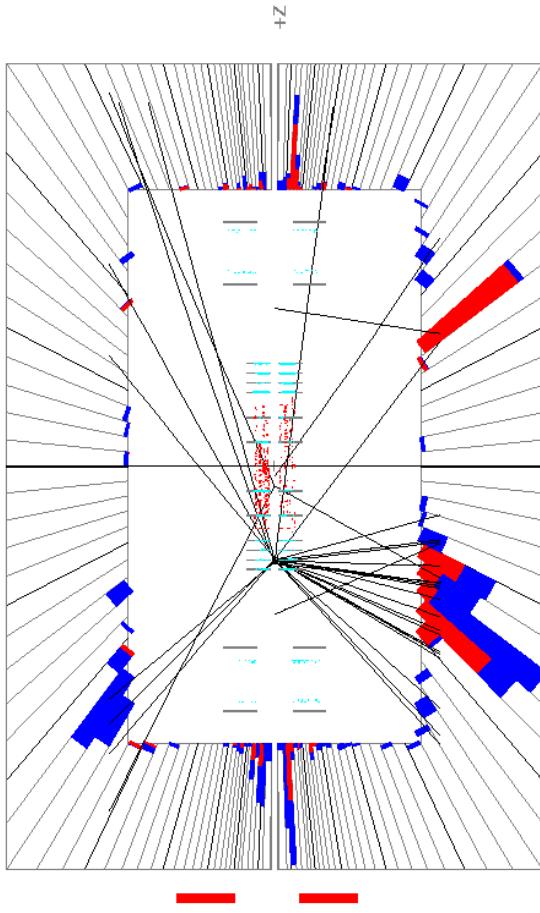


Event Display

$t\bar{t} \rightarrow \mu\nu e\nu jj$ candidate



E scale: 29 GeV

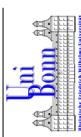


μ pt 58 GeV
 e pt 20 GeV
 Jet pt 141 GeV
 Jet pt 55 GeV



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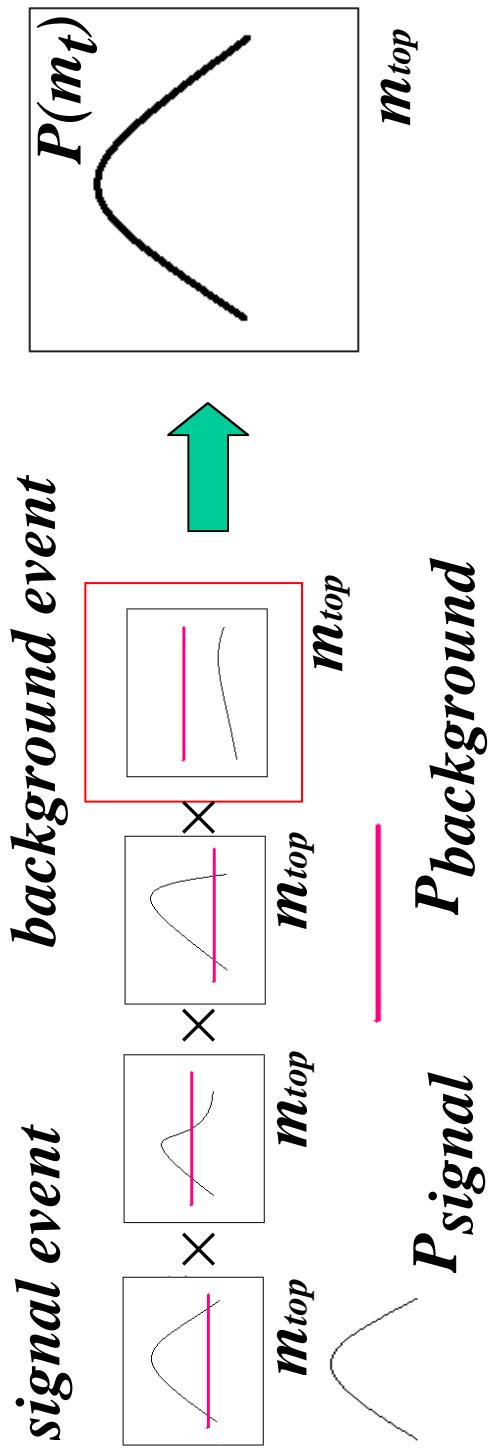
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New Top Mass Measurement (RunI data)

For each event the full kinematic information is used to build a likelihood function. The differential cross section of $t\bar{t}bar$ and $W+jets$ production convoluted with the detector response is used to assign an event signal/background probability as a function of m_{top} .



The goal was to reduce the statistical uncertainty of the measurement and test the new method for RunII data.

New Top Mass Measurement (RunI data)

DØ Statistics RunI (125 pb^{-1})

Standard selection for $t + \text{jets channel}$:

Lepton: $E_t > 20 \text{ GeV}$ $N=1$ $\ell \eta^e < 2$ $\ell \eta^\mu < 1.7$

Jets: $E_t > 15 \text{ GeV}$ $N=4$ $\eta^j < 2$

Missing $E_t > 20 \text{ GeV}$

$E_t W$ 60 GeV

91 events selected

Ref. PRD 58 (1998), 052001:

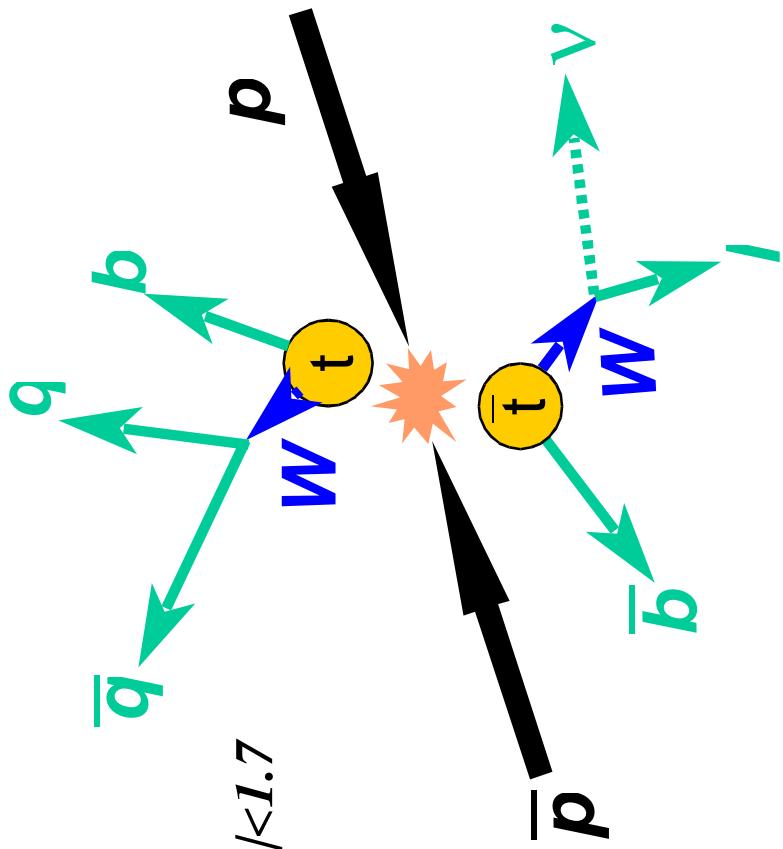
(After χ^2 cut gives 77 events)

12 jet permutations / event

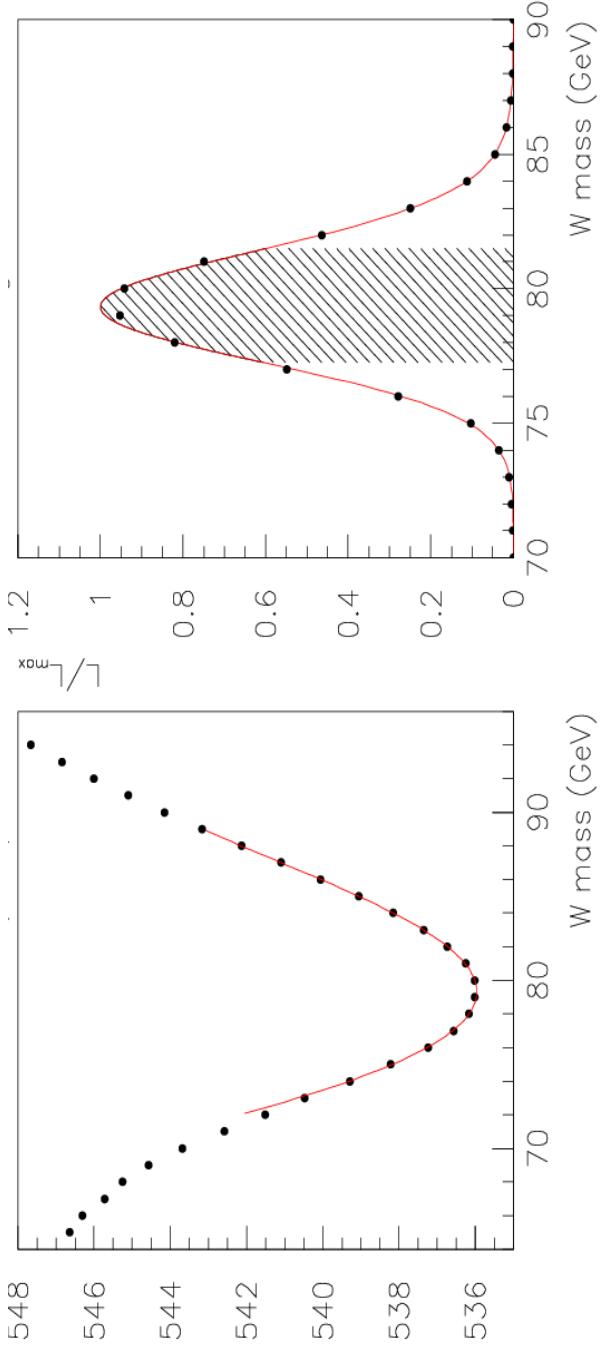
Additional cuts for this analysis:

only events with 4 jets: *71 events*

background prob. : *22 events*



New Top Mass Measurement (RunI data)



*Largest systematic uncertainty: Jet energy scale $\Delta m_{\text{top}} = 5.6 \text{ GeV}$
The possibility of checking the value of the W mass in the hadronic branch on the same events provides a new handle (currently under study).*

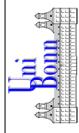
In RunII $Z \rightarrow bb$ decays can be used to limit JES.



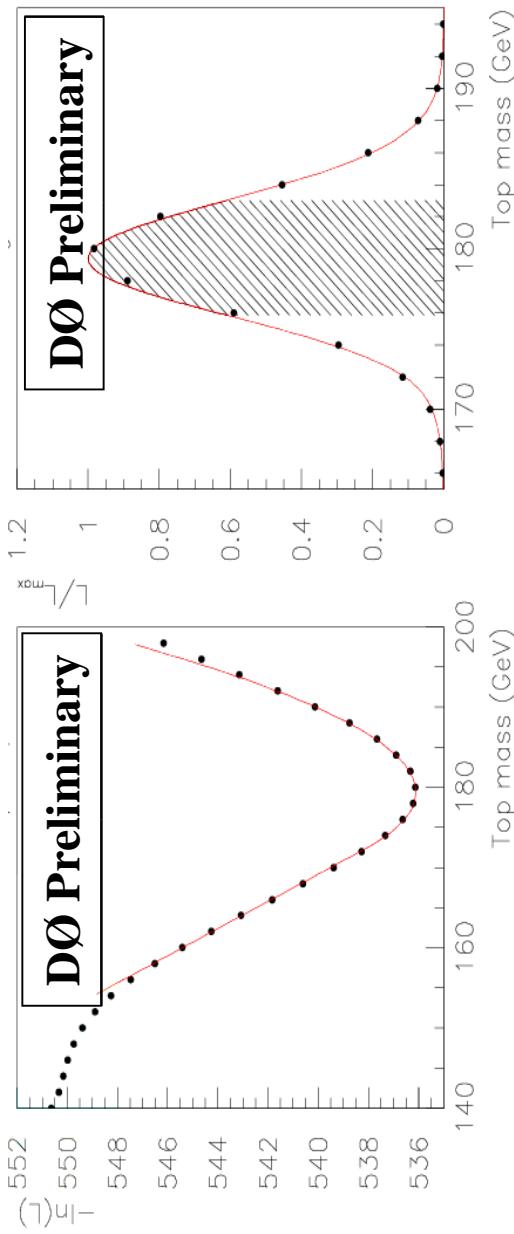
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New Top Mass Measurement (RunI data)



Improvements to previous D0 measurement with:

$$m_{top} = 173.3 \pm 5.6 \text{ (stat.)} \pm 5.5 \text{ (syst.)} \text{ GeV}$$

[PRD 58 52001, (1998)]

- *the correct permutation is always considered*
- *all features of individual events are included, thereby well measured events contribute more than poorly measured events.*
- *discrimination of signal to background improves*
- *systematic uncertainty can be reduced by checking the W mass in hadronic decays*

$m_{top} = 179.9 \text{ GeV}$
 $\pm 3.6 \text{ (stat.) GeV}$
 $\pm 5.9 \text{ (syst.) GeV}$
(Preliminary)



Summary

We continue to take advantage of the well understood RunI data to improve methods and measurements (m_{top} & top properties).

The exciting era of Run II has started. Performance of upgraded D \emptyset detectors are close to expectations, with many improvements relevant to top physics.

We analyzed about 50 pb^{-1} and much more data is to come...

We see candidate events in all $t\bar{t}bar$ channels.

Tevatron Run II will allow to precisely measure W, Z and top quark properties. Signs of new physics could well show up first in these measurements.

